

A
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I N T R O D U C T I O N
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G E O G R A P H Y ;

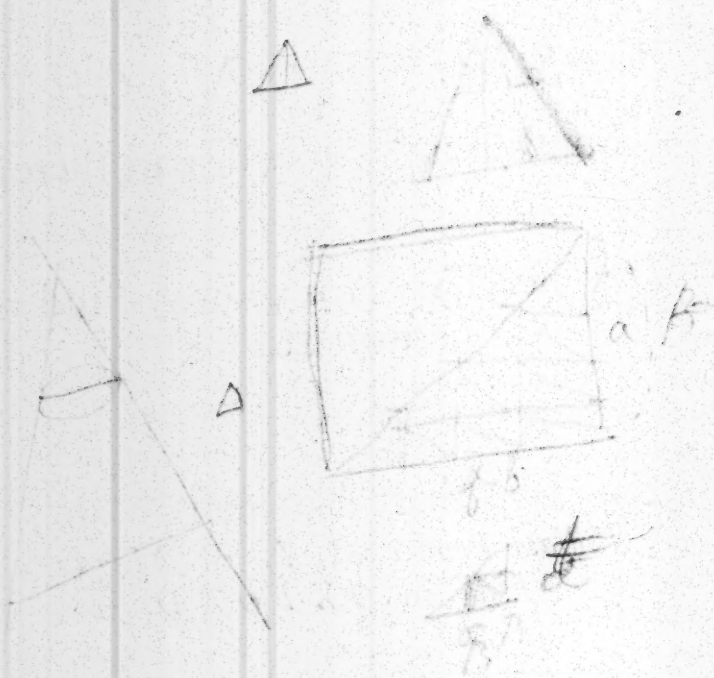
CONTAINING
A DESCRIPTION OF THE
Grounds, and general part thereof.

Very necessary for young Students
in that Science.

Written by that Learned Man, Mr.
William Pemble M. A. of Magdalen
Hall in OXFORD.

O X F O R D,

Printed by *Leonard Lichfield* Printer to the
University for *Anthony Stephens* Book-
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$a: a'; a'b': a'b$
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To the Reader.

GEntle Reader ; I here present unto thy
view these few sheets, written by that
Learned man Mr. **WILLIAM PEMBLE**,
I doubt not to call him the father, the child
favours him so much. It hath long laid hid
from thy sight, but now at length embold-
ned upon thy courteous acceptance of his
former labours, it looks abroad into the
World: It is but little, let not that detract
any thing from it, there may ly much, though
pend up in a narrow room; when thou
readest, then judge of it; Thus much may
be said; Though many have writ of this
subject, yet this inferiour to none; thou maist
observe in it, an admirable mixture of Art
and delight, so that for younger Students
it may be their Introduction, for others a re-
membrancer, for any not unworthy the per-
usal: onely, let it find kind entertainment
at thy hands. Farewell.

To the Reader

Dear Reader, I have presented unto you
this little book, written by that
learned man Mr. WILLIAM PAMPHLET,
I doubt not to call him the father of the school.
I account him so much, it hath long been
form thy sight, but now at length embodied.
I need upon thy courteous acceptance of his
former labours, it looks like a new
itself: it is but little, but not that I mean
any thing from it, there may be much though
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at thy hand.



BRIEF INTRODUCTION
TO
GEOGRAPHY.

CHAP. I.

A general description and division of Geography.

TOPOGRAPHIE is a particular description of some small quantity of Land, such as Land-measurers set out in their plots.

Chorography is a particular description of some Country, as of *England, France*, or any shire or Province in them: as in the usual and ordinary Map.

Geographie is an art or science teaching us the general description of the whole earth, of this especially we are now to speak of, and also Chorography as a part under it contained; both, excellent parts of knowledge in themselves, and affording much profit and help in the understanding of history and other things.

The parts of Geography are two.

General, which treateth of the nature, qualities, measure, with other general properties of the earth.

Special, wherein the several Countries and Coasts of the earth are divided and described.

Of the general in the first place, and more at large than of the other, because it is more difficult and hard to be understood, and yet of necessary use, for the understanding of the other. This general tract may be parted into five particular heads.

1. Of the properties and affections of the earth.
 2. Of the parts of it.
 3. Of the Circles of it.
 4. Of the distinction and division of it, according to some general conditions and qualities of it.
 5. Of the measuring of it.
- These in their order.

CHAP. II

Of certain general properties of the earth.

IN Geography when we name the earth we mean not the earth taken severally by it self, without the Seas and Waters. But under one name both are comprised, as they are now mingled one with another and do both together make up one entire and round body. Neither do we dive into the Bowels of the earth, and enter into consideration of the natural qualities, which are in the substance of the earth and water, as coldness, driness, moisture, heaviness, and the like : but we look only upon the outside, contemplating the greatness, situation, distances, measuring, and other such affections which appear in the superficies of it, to the eyes of our bodies and minds : These then of the earth and water together, rules are to be known.

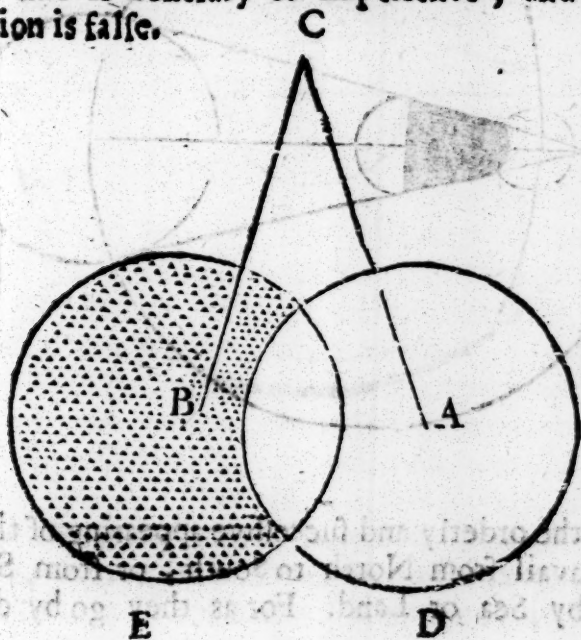
1. *The earth and water do make one Globe, i. e. one round or spherical body.*

The natural place of the water is to be above the earth, and so it was in the first creation of it, compassing the earth round about, as appears, *Gen. 1. 9.* But for the use of man and all other living creatures, God made a separation of them, causing the water to sink down into huge hollow channels, prepared to receive it, that so the dry land might appear above it. Notwithstanding which separation, they do both still remain together, not covering one another as at first, but intermingled one with another, and that so exactly as they now make but one round

body, whereas at first they made two. Here there are two points to be proved, 1. That they are one. 2. That this one is round.

They are one Globe, having the same Center or point, and the same surface or convexe super-; which will appear by these reasons.

Common Experience. Take a lump of Earth and quantity of water, and let them both fall down together upon the Earth from some high place, we see in the descent they do not sever, but keep still together in one straight line, which could not be, if Earth and Water were two several round bodies, having centers. As for example, suppose them to be two, and let (a) be the center of the Earth, and (b) center of the Water; from (c) some high place on the Earth, hurle down Earth and Water, I say Earth will part from the Water in going down, and Earth will fall down upon (d) and the Water upon (e) this is contrary to Experience, and ergo the supposition is false.

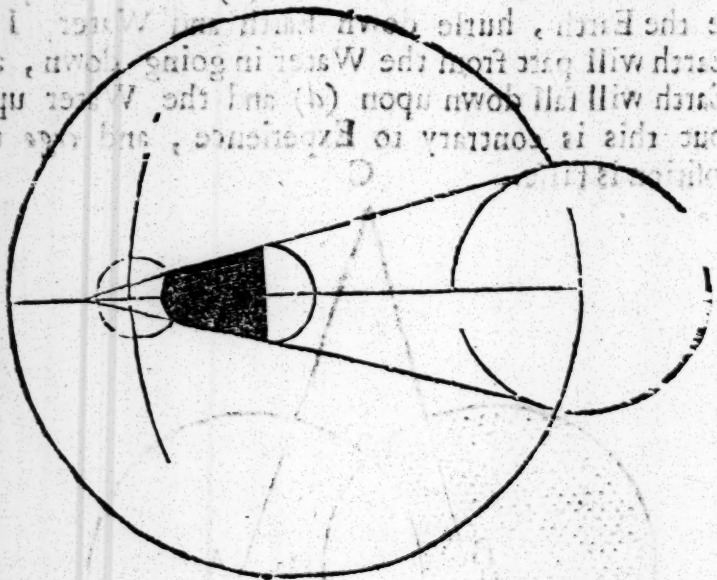


2. The

2. The shadow which in Eclipses is cast upon the Moon by the Earth and the Water, is but one and not two, and therefore the body is so likewise. This will appear in the proof of the next point, v. 2.

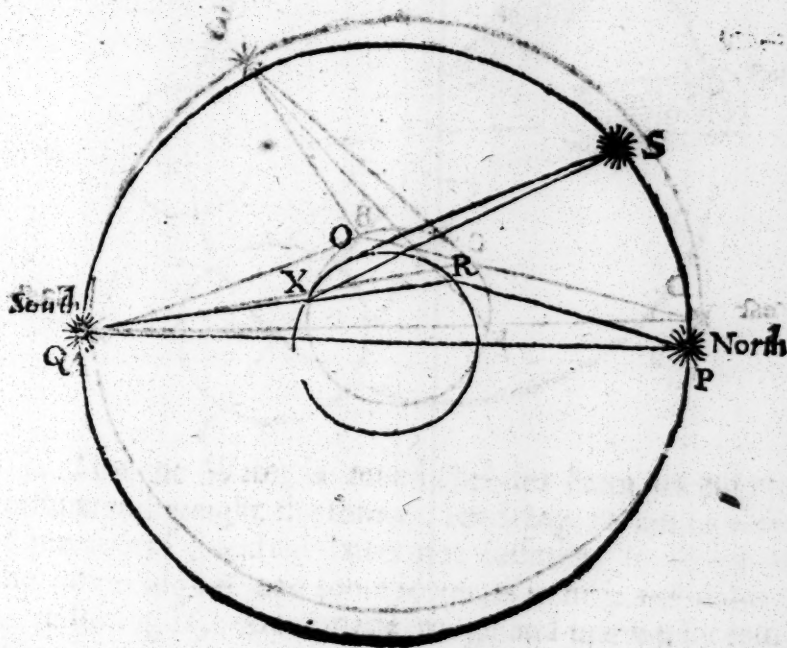
2. That both Earth and Water are one round body, not square, long, hollow, or any other figure. This is proved by divers reasons.

1. By Eclipses; when the Earth stands just between the Sun and the Moon, then doth the shadow of the Earth falling upon the Moon darken it wholly or in part. Now as is the fashion of the shadow, such is the figure of the body, whence it falls, but the shadow of the Earth and Water cast upon the Moon is round, and also one, therefore they are round and also one body.



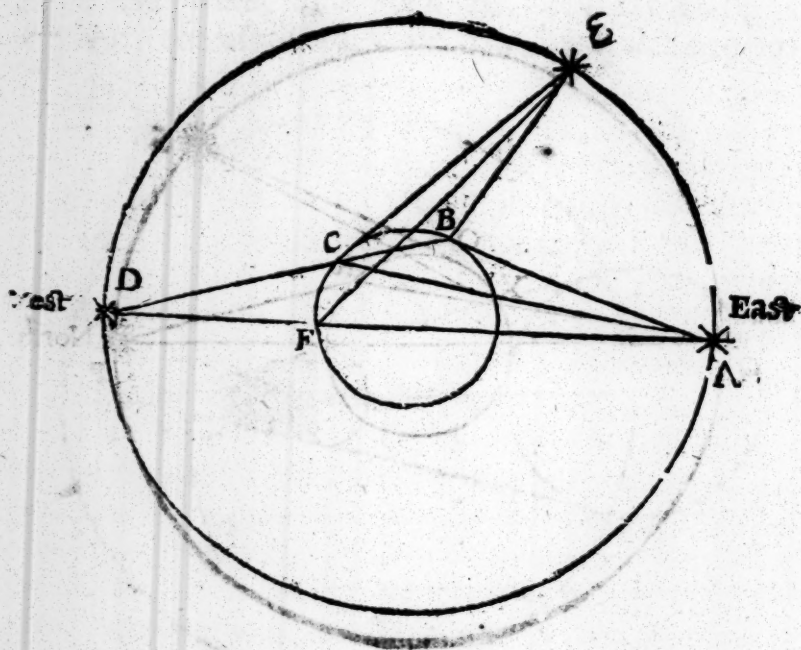
2, By the orderly and successive appearing of the stars, as men travail from North to South, or from South to North, by Sea or Land. For as they go by degrees, they

they discover new Stars, which they saw not before: and lose the sight of them they did: which could not be, if the Earth were not round. As for example, let (XOR) the inward Circle be the Earth, (QSP) the outward, the Heaven: they which dwell upon the Earth in (X) cannot see the Star (S) : but if they go Northward unto (O) they may see it. If they go farther to (R) they may see the Star (P) : but then they lose the sight of the Star (Q) which, being at (X) and (O) , they might have seen. Because, as it appears in the figure, the earth riseth up round between (R) and (X) .



3. By the orderly and successive rising of the Sun and Stars, and setting of the same. Which appear not at the same time to all countries; but unto one after another.

As for example, let (FCB) be the Circle of the Earth, (DEA) the Circle of the heaven from East to West; let (A) be the Sun or a Star. When the Sun (A) is up, and shines upon them that dwell in (B) ; he is not risen to them that dwell in (C) . Again when he is risen higher and is come to (E) and so shines to them that dwell in (C) ; he is not yet up to them that dwell in (B) . Again when he sets in the West in (D) and so is out of sight to the inhabitants in (B) ; he is yet up to them that dwell in (C) and (F) . Which shews plainly the Earth is round.



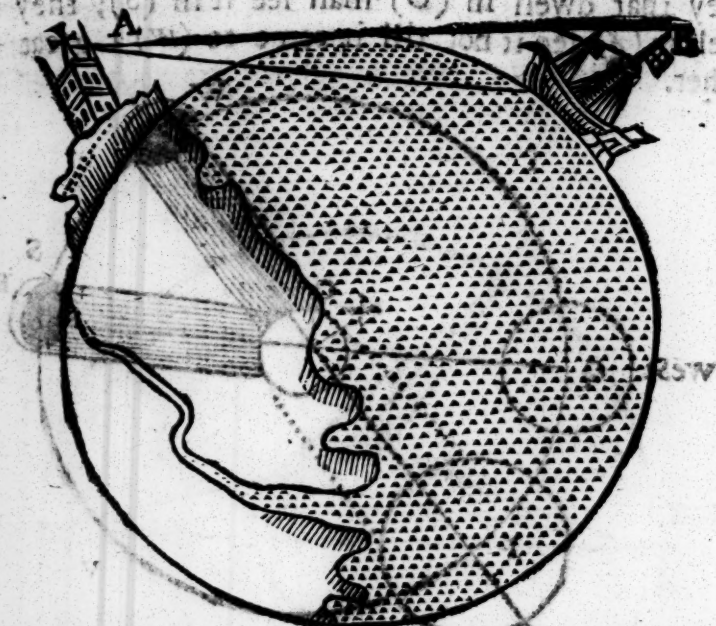
4. By the different observations of Eclipses, One and the same Eclipse appearing sooner to the Easterly Nations than those that lie farther West; which is caused by the bulk of the Earth rising up between. As for example, let

B 2

Let

Let (A) be some Steeple on the Land, (B) a ship at Sea : He that stands at (A) shall by little and little lose the sight of the ship as she goes out ; and get sight of her as she comes in. Both first and last he shall have the sight of the top mast (B) when he sees nothing else ; Because the Sea riseth up between his sight and the ship.

These reasons and experiments may suffice to prove



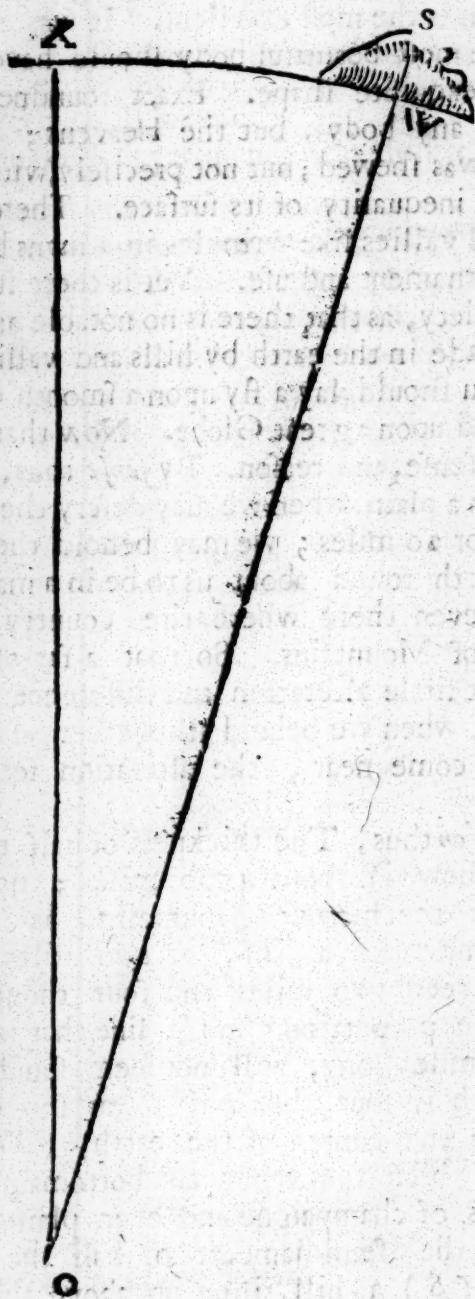
the roundness of the Earth and Water ; which might be farther demonstrated by shewing the falshood of all other figures regular or irregular that can be given unto it : that it is neither square, nor three corner'd, nor Pyramidal, nor Conical or Taperwise, nor Cylindrical like a barley-cowb, nor hollow like a dish, nor of any other fashion as some have imagined it to be. We come to the second rule,

2. The tops of the highest Hills, and bottoms of the lowest Vallies, although in several places they make the Earth uneven, yet being compared to the vast greatness of the whole, do not at all hinder the roundness of it.

Among all Geometrical figures the spherical or the round is the most perfect, and amongst all natural bodies the heaven is the most excellent. It was therefore good reason the most beautiful body should have the most perfect and exquisite shape. Exact roundness then is not found in any body, but the Heavens; the Earth is round, as was shewed; but not precisely, without all roughness and inequality of its surface. There are hills like warts, and vallies like wrinkles in a mans body; and that both for ornament and use. Yet is there such uniformity in this variety, as that there is no notable and sensible inequality made in the earth by hills and vallies. No more then if you should lay a fly upon a smooth Cart-wheel, or a Pins head upon a great Globe. Now that this is so, appears by sense, and reason. By *sense* thus, If we stand on a hill or in a plain, when we may descry the country round about 15 or 20 miles; we may behold the brim or edge of the Earth round about us to be in a manner even and streight, even there where the country is very hilly, and full of Mountains. So that a-far off their height makes but little alteration and difference from the plain countries, when we behold altogether a-far-off: though when we come near, the alteration seems more sensible.

By *reason* thus, The thickness of half the Earth is (as shall be shewed) about 4000 miles; now the plumb-height of the highest Mountains, is not accounted above a mile and a half, or two miles at the most. Now between two miles and four thousand there is no sensible proportion: and a line that is four thousand and two miles long, will not seem sensibly longer then that which is four thousand; as for example. Let (O) be the center of the earth, (XW) a part of the earth which runneth by the bottoms of the hills, and superficies of champaigne and even plains, (WO) or (XO) the semidiameter or half the depth of the earth, (S) a hill rising up above the plain of the earth

earth, (*WS*)
 the plumb
 height of the
 hill. I say that
 (*WS*) doth not
 sensibly alter
 the length of
 the line (*OW*):
 for (*WS*)
 is but two,
 (*WO*) 4000
 miles, and two
 to 4000 al-
 ters not much
 more; than the
 breadth of a
 pin to the
 length of a
 perch. So a
 line drawn
 from (*O*) the
 center to (*S*)
 the top of the
 hill, is in a
 manner all
 one with a
 line drawn
 to (*W*) the
 bottome of
 the hill.



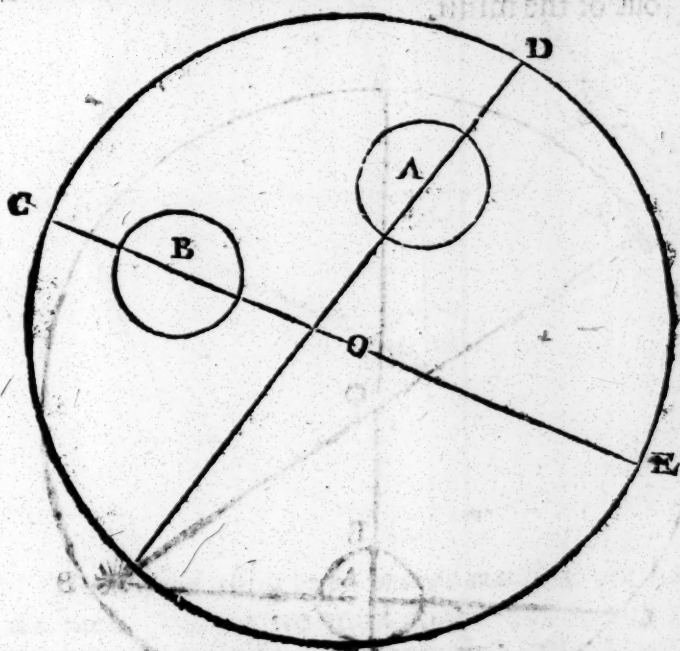
The third Rule.

3. The earth resteth immovable in the very midst of the whole world.

Two points are here to be demonstrated, First that the earth standeth exactly in the midst of the world: Secondly that it is immovable. The former is proved by these reasons.

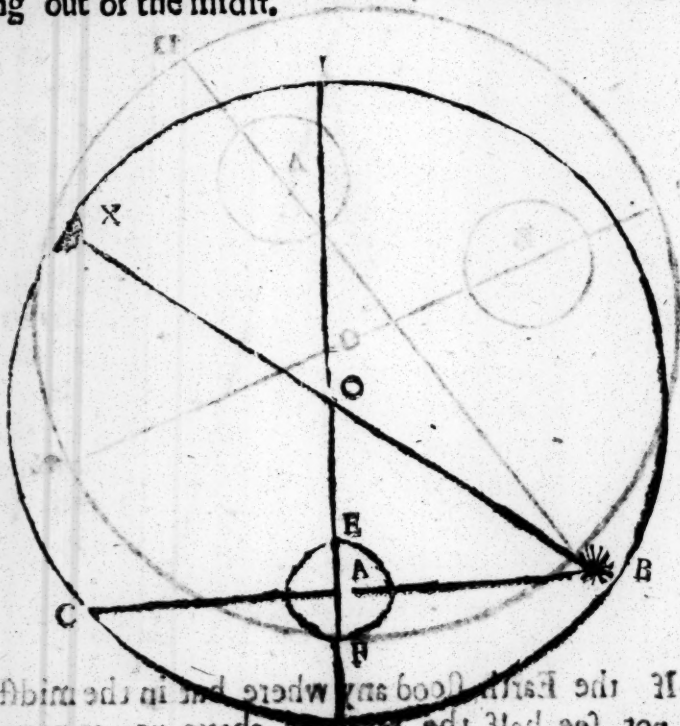
1. The natural heaviness of the earth and water is such, as they will never cease moving downwards till they come to the lowest place: now the center or middle point of the World is the lowest place; and ergo they must needs move thither. as foreexample.

Let (O) be the center of the world, (CDE) the heavens: it is manifest that the lowest place from the heavens on all sides is (O). Suppose the earth to be in (A) or in (B) some where out of the center, I say it is not possible (unless it be violently held up) that it should abide there, but it will descend till it come to (O) the middle point.



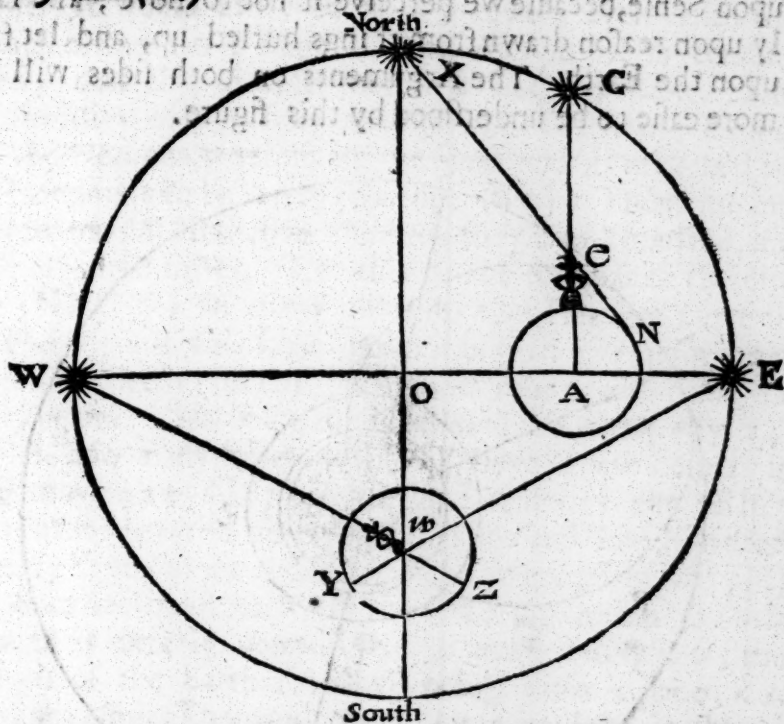
2. If the Earth stood any where but in the midst we should not see half the Heavens above us, as now we do,

do, neither could there be any Equinox; neither would the days and nights lengthen and shorten in that due order and proportion in all places of the World as now they do; again Eclipses would never fall out but in one part of the Heavens, yea the Sun and Moon might be directly opposite one to another and yet no Eclipse follow, all which are absurd. As for Example, let the center of the World be (O) let the Earth stand in (A) a good way distant from the center: it is manifest that the greater part of the Heavens (CIB) will allways be above, and the lesser half (CDB) below; which is contrary to experience. Thence also it follows that the days and nights will never be equal, for the Sun (B) will be allways longer above the Earth whilst he moves from (B) to (C) then below, moving from (C) to (B.) Again the Sun (B) may stand just opposite to the Moon (X) and yet no Eclipse follow, the Earth which makes the Eclipse standing out of the midst.



2. If the Earth stood any where but in the middle we should not see half the heavens above us, as now we

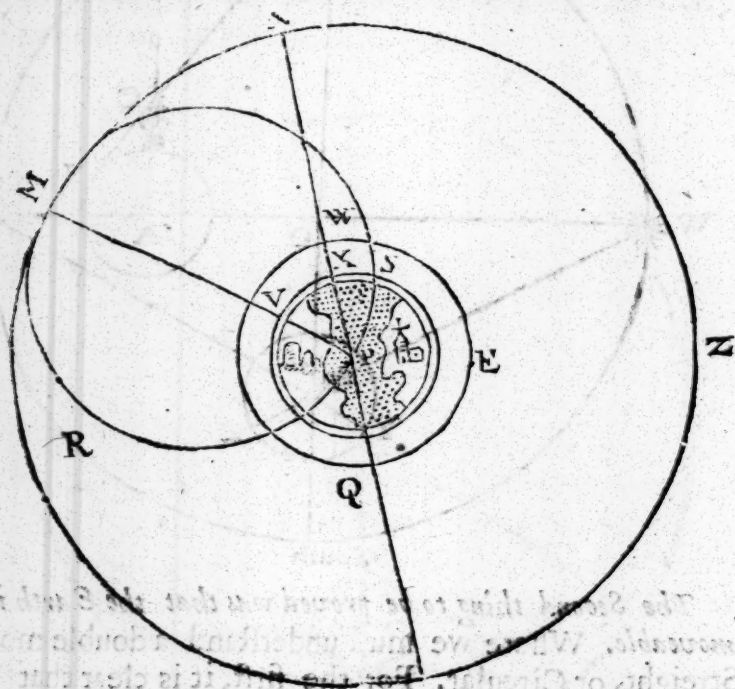
3 The shadows of all bodies on the earth would not fall into that orderly uniformity as they do, for if the earth stood towards the East, the shadows would be shortest before noon; if towards the west, after noon; if towards the North, the shadows would still fall Northward; if towards the South, Southwards: all which experience shews to be false. As for example, let the earth stand Eastwards in (A,) the shadow of any body upon the earth, as of the body under (c) will be shorter in the morning when the Sun is in (C) then at noon when the Sun is in (X:) if the Earth stand Southward in (W) the shadow of any body will allways fall South, as it doth in the figure (Y) and (Z.)



The Second thing to be proved was that the Earth is immoveable. Where we must understand a double motion, Streight, or Circular. For the first, it is clear that without supernatural violence it cannot be moved in any streight

streight motion, that is, upwards, downwards or towards any side it cannot be shoved out of its place.

For the Second, whether abiding still in its place it may not move round, the question is disputed, and maintained on both sides. Some affirm it may and doth: who think there is greater probability the Earth should move round once a day, then that the Heavens should, by reason of the incredible swiftness of the Heavens motion, scarce comparable to any natural body; and the more likely slowness of the Earths moving. Others deny it, grounding their opinion upon Scripture, which affirms the Earth to stand fast so that it cannot be moved; and upon Sense, because we perceive it not to move; and lastly upon reason drawn from things hurled up, and let fall upon the Earth. The Arguments on both sides will be more easie to be understood by this figure.



In this figure it is manifest that the Earth in the midst

dest cannot move by any streight motion, upward toward (N;) or sideward toward (M;) or any other way out of its proper place: and therefore that opinion of *Copernicus* and others, that the earth should move round once a year in such a circle as (MPR,) is most improbable and unreasonable, and rejected by the most.

But altho it cannot move streight, it may move round. For tho it be a marvelous great body of unconceivable weight, yet being equally poised on every side, there is nothing can hinder its circular motion: as in a Globe of Lead, or any other heavy substance, tho it were Forty Fadome in compass, yet being set upon its Two Poles it would easily be turned round, even with the touch of ones little finger. And therefore it is concluded, that this circular motion is not impossible. The probability of it is thus made plain. The whole circuit of the Heavens, wherein are the fixed Stars, is reckoned by Astronomers to be 1617562500, (i.e.) a Thousand and Seventeen Millions, five Hundred sixty two Thousand, and five Hundred miles. Let this be the compass of the circle (NMOZ.) So many miles do the Heavens move in one day, till the same point come to the place from whence it went; as till (N) move round and come to (N) again. This being the motion of the whole day 24. hours, how many miles will (N) move in one hour? it will move 42398437 and a half, i.e. Forty two Millions three Hundred ninety eight Thousand four Hundred Thirty seven miles and a half. So many miles will (N) move in one hour from (N) to (M.) A motion so swift that it is utterly incredible. Far more likely it is, the circuit of the Earth (ASXY) being about 24000, i.e. Twenty four Thousand miles more or less: it should move round once a day. For then one point as (X) should move in one hour from (X) to (V) but a Thousand miles; which motion altho it be swifter than any arrow or bullet from the canons mouth; yet it is incomparably slower than that of the Heavens, where so many Millions are posted over in an hour.

Now for the solving of the Celestial Phenomena, or appearances, the truth is the same, if we suppose the earth to move; as if we believe it to stand still. The rising of the Sun and stars, the motions of all the Planets, will keep correspondence as now. Nor ^{now} we fear Jogging; or that Steeples and Towers would totter down: for the motion is regular, and steady without rubs and knocks. As if you turn a globe round; it will go steadily, and a fly will sit fast upon it, though you move it apace. Besides, the whole body of the aire is carried about with the whirling of the Earth: so that the Earth will make no wind, as it turns swiftly about; as a wheel will, if it be turned apace.

Notwithstanding all this, most are of another opinion, that the Earth standeth still without all motion, rest rather befitting so heavy and dull a body, then motion. The main reason brought to establish it is this. Let a Stone be thrown down out of the aire from (W;) if the earth stand still, it is manifest it will fall upon (X) just under it, as we see it doth. By common experience a stone will fall down from any height upon the place we aimed at: but let the Earth move, the stone will not light upon (X,) but somewhere else as upon (S;) for (X) will be moved away and gone to (V.)

So again let two pieces of ordinance that will shoot at equal distance be discharged one just towards the East, the other towards the West: if the Earth move (as they say it doth) towards the West, the bullet that is discharged Eastward will fly farther then that Westward. For by the contrary motion of the Earth it will gain ground. But experience hath proved this to be false, shewing that the bullets fly at equal distance.

To salve this, answer is made, that the Earth by its swift motion carries with it, and steadily, not only all bodies resting or moving upon it, but also the whole Sphere of Air (WEQ) with all things whatsoever that are moved in it naturally or violently, as Clouds, Birds, Stones hurled

hurled up or down, arrows, bullets, and such like things violently shot forth: as may appear in the figure.

The Fourth Rule.

4. *The earth, tho it be of exceeding great quantity being considered in it self, yet being compared to the heavens, especially in higher spheres, is of no notable bigness, but may be accounted as a point or prick in the midst of the World.*

That the earth is no bigger than a point or pins head in comparison of the highest heavens, will easily appear unto us, by these reasons.

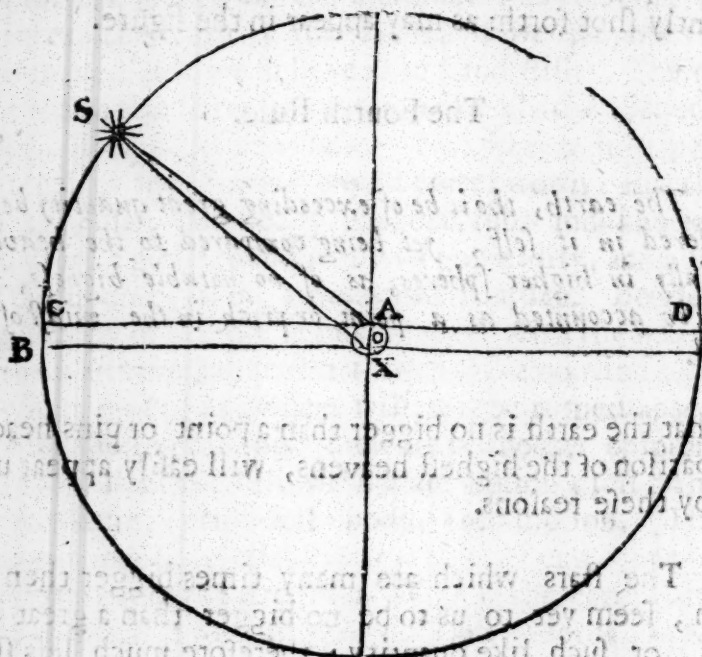
1. The stars which are many times bigger then the Earth, seem yet to us to be no bigger than a great pins head, or such like quantity; therefore much less shall the earth appear to be of any sensible magnitude.

2. We allways behold half the Heavens above us, which could not be if the Earth had any sensible proportion to the Heaven.

3. All observations of heights and distances of the Celestial bodies, which are made on the superficies of the Earth, are as exact, and true, as if they were made in the very center of the Earth. (Which were impossible, unless the thickness of the Earth were insensible in regard of the Heavens.)

4. All Sun Dials which stand on the Superficies of the earth, do as truly cast the shadows of the houres, as if they stood in the Center. As for Example.

The



The Star (S) appears like a point or prick to them that dwell in (A;) wherefore the Earth (OX) will appear much less to the sight of him that should behold it from (S;) nay it would not be seen at all. Again, half the Heavens, (BFE) is allways seen to them that dwell in (A) wanting some two minutes, between (ED) and (BC;) which difference is altogether insensible. Again if we observe the height of the star (S) above the Horizon (BE;) it will be all one namely (BS) whether we observe it in the Top of the Earth, in (A) or in the middle in (O.) For (A) and (O) are so little distant one from another, that (AS) and (OS) will be parallel lines, and be esteemed but as one Line. The fourth reason concerning Dials, is clear by the framing and construction of them: wherein either the lower end of the Cock (or Gnomon) whereat all the houre lines meet, or the upper end and knob (as in many dials) is supposed to be the Center of the Earth.

CHAP.

CHAP. III.

Of the Parts of the Terrestrial Globe.

THe properties of the earthly Globe have been handled in the former chapter, we come now to the parts which are two in general

{ *Earth* } Both contain under them more particular parts to be known.
{ *Water* }

The more notable parts of the *Earth* are these.

1. A *Continent* or main Land, or as some call it firm-Land; which is not parted by the Sea running between.
 2. An *Island*, a Land compassed about with Waters.
 3. A *Peninsula*, a Land almost surrounded by waters, save at one place, where it joyns by a narrow neck of Land to the Continent; this is also called *Chersonesus*.
 4. An *Isthmus*, a streight neck of Land which joyns two countries together and keeps the Sea from compassing the one.
 5. A *Promontorie* or head Land running farr out into the Sea like a wedge.
 6. A *Mountaine*
 7. A *Valley*
 8. A *Champion-plain*
 9. A *Wood*
- } All easie to be known without any definition.

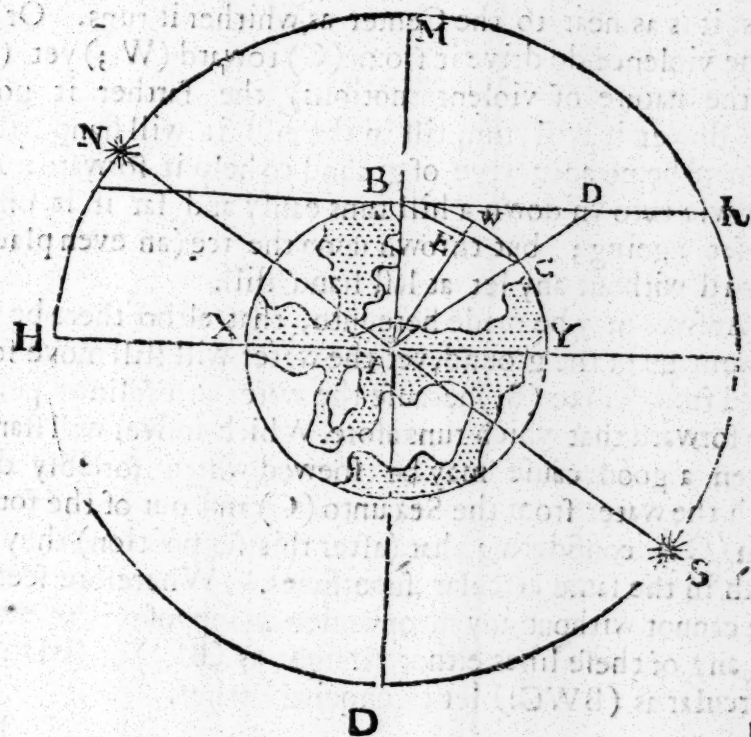
The more notable parts of the *Water* are these:

1. *Mare* the Sea, or Ocean, which is the gathering together of all waters.
2. *Fretum* a streight or narrow sea running between two lands.
3. *Sinus* a Creek, Gulf or Bay, when the Sea runs up into the bosome of the Land by a narrow entrance, but openeth broader when it is within: if it be very little it is called a Haven *Portus*.
4. *Lacus* a Lake, a little Sea within the Land having rivers running into it, or out of it, or both. If it hath neither, it is called *Stagnum* a standing Poole, also *Palm*, a fenne.

5. *Fluvius* a River, which from the pleasantness is also called *Amnis*; From the smallness *Rivus*.

Now concerning these *parts* divers questions are moved: whether there be more Sea or Land? whether the Sea would naturally overflow the Land, as it did in the first Creation, were it not withheld within its banks by divine power? whether the deepness of the Sea doth exceed the height of the Mountains? whether mountains were before the Flood? what is the height of the highest hills? whether Islands came since the flood? what is the cause of the Ebbing and Flowing of the Sea? what is the original of Springs and Rivers? what manner of motion the running of rivers is? with such like, whereof some belong not so properly to this science of Geography as to others. We speak only a word or two of the last, and so proceed. The question is whether the motion of Rivers be straight or Circular. The doubts on both sides will best appear by a figure first drawn: wherein, let (HMO) be the Meridian of *Alexandria* in *Egypt*, or of the mouth of *Nilus*, and answerable to the Meridian of the Heavens. Another in the Earth (XBY.) let (B) be the mouth of *Nilus*, and (C) the fountain and head of it. Now the Mouth of *Nilus* where it runs into the Mediterranean Sea, is placed by Geographers in the 31 degree of the North Latitude; and the head of *Nilus* where it riseth is placed by *Ptolomæus* in 11. degree of the South latitude; but by later and more exact Geographers in the 14 degree of the Southern latitude: so that the distance between the founts and *Ostia*, i. e. between (C) and (B) is 45 degrees of a great Circle, which after the usual account makes 2700. one eight part of the earths compass. The question now is, whether the running from (C) to (B) continually downward be in a straight line, or circularly in a crooked line. If it run in a straight line, as is most agreeable to the nature of the water, it must move either by the line (CEB;) or by the line (DB.) By the line (CEB)

(CEB) it cannot move, for when it is come to (E) it will stand still: Because from (E) to (B) it must move upward; if it move at all; which is contrary to the nature of water. If therefore it move by a straight line, it can be no other but (BD,) and so from (D) to (B) it shall continually descend; for of all places between (D) and (B,) (B) is the nearest to (A:) But then the fountain must not be in (B,) but higher in (D) which seems altogether improbable or impossible. For first the line (AD) would be notable and sensibly longer then the line (AB.) For the compass of the Earth being about 2400. miles, and the semidiameter (AB) or (AC) 3828. miles, the line (CD,) would be 1581. Miles: which cannot be true, if, as we have proved before, the Earth be round, and the highest hills make no sensible inequality. Again they that dwell in (D) should see the North Pole star (N) as well as they that dwell in (B,) which also is false. So then

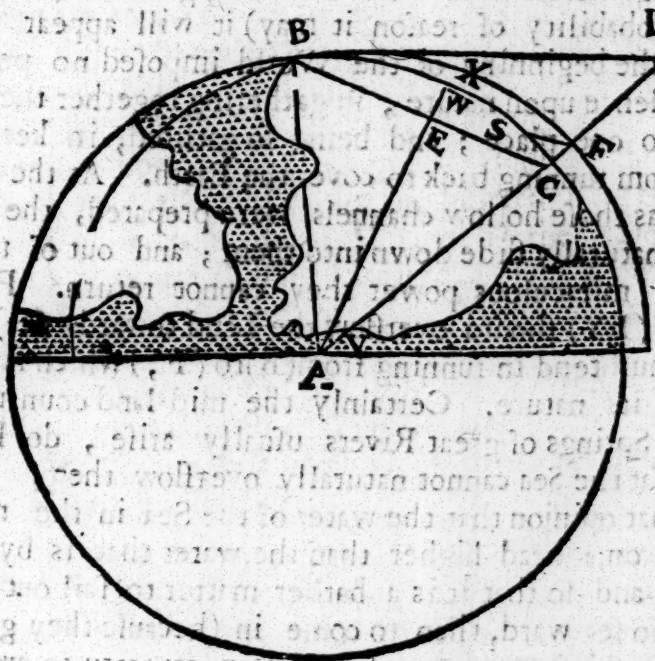


the River cannot run either by (EB) or (DB.) Runs it then circularly by the line (CWB?) This seems probable; and the rather because hereby a reason of the original of Rivers might more easily be given. For the fountaine (C) lying even with the Superficies of the Sea the water may easily pass through the hollows of the Earth, and break out at (C) without ascending. But here also are some difficultes: for first we find by experience that the fountains of most Rivers, and those great ones too, lie sensibly higher than the plain surface of the Sea. Again, if the River move directly round, what should be the cause that begins and continues this motion? It is a motion besides the nature of the water, and therefore violent: what should then drive it forward from the Sea to (C) and from (C) to (B?) when the water is at (C) or (W;) it is as near to the Center (A) as when it is at (B;) and therefore it should seem with more likelihood it would stand still. for why should it strive to go farther, seeing where it is, it is as near to the Center as whither it runs. Or if some violence do drive it from (C) toward (W;) yet (as is the nature of violent motions) the farther it goes the slower it will run, till in the end it will stand still; if there be no advantage of ground to help it forward: As a bowle thrown down a hill runs easily and far if it once be set a going; but thrown upon the ice (an even place) it will without any let at last stand still.

Answer may be made hereunto, that altho there be no advantage of the ground, yet the water will still move forward from (C) to (B;) because the water that follows pusheth forward that which runs afore. Which answer will stand, when a good cause may be shewed which forcibly driveth the water from the Sea unto (C) and out of the fountain (C;) considering that (after this supposition) they lie both in the same circular superficies. Wherefore seeing we cannot without any inconveniency suppose it to move by any of these lines either straight as (BC) or (BD;) or Circular as (BWC;) let us enquire farther.

The

The most likely opinion is, that the motion of the Water is mixt neither directly straight, nor circular, but partly one, partly the other. Or if it be circular, it is in a circle whose Center is a little distant from the Center of the whole Globe. Let us then place fountains neither in (C) nor (D,) but in (F.) I say the water runs either *partly straight* by the line (FS,) and *partly circular*, from (S) to (B) (which motion will not be inconvenient, for the water descending continually from (F) to (S) will cause it still to run forward :) or else *wholly circular* in the circle (FXB.) And this is most agreeable to truth. For so it shall both *run round*; as it must do if we will escape the otherwise unavoidable inconveniences of the first opinion: and also in running still *descend*, and come nearer to the center, as is most befitting the nature of water; so that we need not seek for any violent cause that moves it. Let us then see what is the height of (F) the fountains of *Nilus*, above (C) (*i. e.*) (B) the mouth or outlet of it.



into the Sea. The usual allowance in water-courses is one foot in descent for 100 foot in running, but if this be thought too much (because water will run away upon any inequality of ground) for every 500 foot allow one for descent: and so much we may with reason, in regard of the swiftness of many, yea the most Rivers, which in many places run headlong, in all very swiftly (especially *Nilus* whose cataracts or downfalls are notable) which cannot be without some notable declivity of the ground. Thus then the whole course of *Nilus* being 2700 miles from (F) to (B:) the perpendicular or plumb descent of it (CF) will be 5 miles. And so high shall the Fountain stand above the mouth; and the surface of the plain land (for Rivers commonly arise at foot of hills) which is (BXF) swell up above the surface of the Sea (BWC) or (BY:) which height of the land above the Sea, altho it be greater than is the height of the highest Mountains above the plain land; yet it is nothing in comparison of the whole Earth. And this being granted (as with more probability of reason it may) it will appear that God in the beginning of the World imposed no perpetual violence upon nature, in gathering together the waters into one place; and being so gathered, in keeping them from running back to cover the Earth. At the first so soon as those hollow channels were prepared, the water did naturally slide down into them; and out of them without miraculous power they cannot return. For if the Sea (BY) should overflow the Land towards (F) the water must tend in running from (B) to (F;) which is contrary to its nature. Certainly the mid-land countries, whence Springs of great Rivers usually arise, do ly so high, that the Sea cannot naturally overflow them. For as for that opinion that the water of the Sea in the middle lies on a head higher than the water that is by the shore; and so that it is a harder matter to sail out of a Haven to sea-ward, then to come in (because they go upward:) this is an empty speculation contrary to experience

ence, and the grounds of nature it self, as might easily be shewed. All the difficulty that is in this opinion, is to give a reason how the waters mount up to (F;) and whence the water comes that should flow out of so high a place of the Earth: wherein I think, as in many other secrets of nature, we must content our selves with ignorance; seeing so many vain conjectures have taken no better success.

CHAP. IV.

Of the Circles of the Earth.

IN a round body as the earth is, there can be no distinction of parts and places, without the help of some lines drawn or imagined to be drawn upon it. Now there are not, nor can be any circles truly drawn upon the earth: yet because there is a good ground in nature and reason of things from thence: we must imagine them to be drawn upon the earth, as truly as we see them described upon a Globe or in a plain paper. Farther this must be noted, that all the Circles on the earth have the like opposite unto them conceived to be in the heavens, under which they are directly scituated. This known, the circles of which that we are to take special notice are of two sorts, Greater and lesser.

The greater circles are those which divide this earthly globe into equal halves or Hemispheares,

The lesser are those which divide it into two unequal parts, one bigger, another lesser.

Of the former sort there
are four, the

1. Equator.

2. Meridian.

3. Horizon.

4. Zodiack, or Ecliptick.

1. The

1. *The Equator or Equinoctial line, is a line drawn just in the midst of the earth, from East to West, which compasseth it as a girdle doth a mans body, and divideth it into two equal parts, one on the North side, the other on the South.* The two points in the earth that are every way farthest distant from it North, and South, are called the *Poles* of the Earth, which do directly stand under the two like points in the Heaven, so called because the Heaven turns about upon them, as the Earth doth in a Globe that is set in a frame. This Circle is of the first and principal note and use in Geography; because all measurings for distances of places and quarters of the earth are reckoned in it, or from it. It is called the *Equinoctial*, because when the Sun in the Heavens comes to be directly over that circle in the earth, the days and nights are of equal length in all parts of the world; Mariners call it by a kind of excellency, *The line*. Upon the Globe it is easily discerned being drawn bigger then any other circles from East to West, and with small divisions.

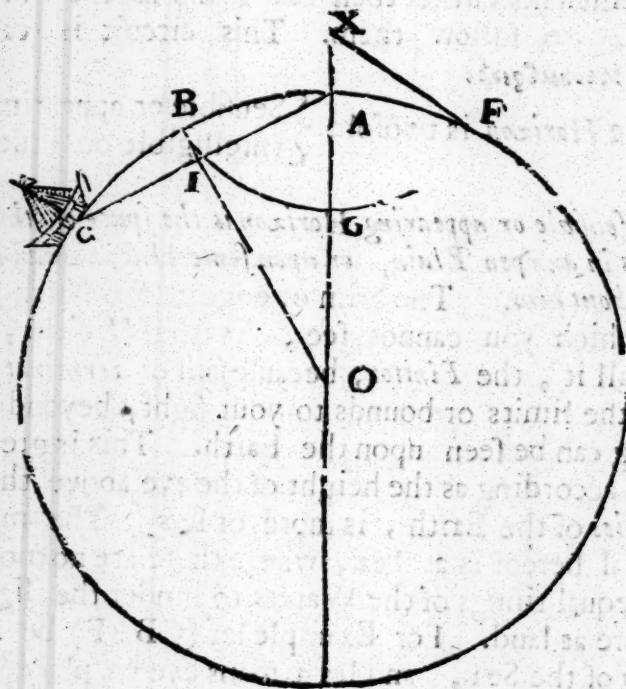
2. *The Meridian, is a line that is drawn quite cross the Equinoctial, and passeth through the Poles of the Earth, going directly North and South.* It is called the *Meridian*, because when the Sun stands just over that circle, it is *Meradies*, i. e. noon day. it may be conceived thus. At noon-day when it is just Twelve a Clock, turn your face towards the South, and then imagine with your self Two Circles drawn, one in the Heavens, passing from the North just over your head through the body of the Sun down to the South, and so round under the Earth up again to the North Pole. Another upon the surface of the Earth passing through your feet just under the Sun, and so compassing the Earth round till it meet at your feet again, and these are Meridians answering one to another. Now the Meridian is not one onely, as was the Equinoctial, but many still varying according to the place wherein you are, as for Example: at *London* there is one Meridian, at *Oxford* another, at *Bristol* another and

and so along Eastward or Westward. For it is noon at London sooner then at Oxford, and at Oxford sooner then at Bristol. Upon the Globe there are many drawn, all which pass through the Poles, and go North and South. But there is one more remarkable then the rest drawn broad with small divisions, which runneth through the Canary Islands of Azores Westward of Spain, which is counted the first Meridian in regard of reckoning and measuring of distances of places one from another: for otherwise there is neither first nor last in the round earth. But some place must be appointed where to begin the account: and these Islands have been thought fittest, because no part of the World that lay Westward was known to the Ancients farther then that: and as they began to reckon, we follow them. This circuit is called in Greek *Μεσημβριος*

3. The *Horizon* is twofold $\left\{ \begin{array}{l} \text{Sensible or appearing.} \\ \text{Intelligible or True.} \end{array} \right.$

The sensible or appearing Horizon is the space of the Earth so far as in an open Plain, or upon some Hill a man may see round about him. The brim or edge of the Earth farther then which you cannot see, is the *Horizon*, or as some call it, the *Finitor*, because *finis* or *terminat visum*, it sets the limits or bounds to your sight, beyond which nothing can be seen upon the Earth. This is greater or Lesser, according as the height of the eye above the plain superficies of the Earth, is more or less. The most exact Trial hereof is at Sea, where there are no mountains nor unequal risings of the Waters to hinder the sight, as there are at land. For Example let (CBAF) be the superficies of the Sea, and let a mans eye be placed in (X) above the Sea; as the eye stands higher or lower, so will the distance seen, be more or less. As if the height of (XA) be six foot which is the ordinary height of a man, the eye looking from (X) to (B) shall see two miles and three quarters: if (X) be 20. foot high (BA) will be five miles,

miles ; if 40. foot 7. miles ; if 50. foot 8. miles. So that from the mast of a Ship 50. foot high , a man may see round about at Sea 8 miles every way , toward (E G) and (F.) So far may the water it self be seen ; but any high thing on the Water may be seen farther 16. or 20. miles according as the height is : as the ship at C may be seen from X as far more as it is from A to B. There can be therefore no certain quantity and space set down for this sensible *Horizon*, which continually varies according to the height of the eye above the plain ground or sea. This *Horizon* is not at all painted on the *Globe* nor can be.



The intelligible or true Horizon is a line which girds the Earth round in the midst, and divides it into two equal parts or Hemispheres, the uppermost, upon the top and middle point whereof we dwell, and that which is under us. Opposite

site to this in the Heavens is another Horizon, which likewise cuts the Heaven into two Hemispheres, the upper and the lower. Above which circle when any star or the Sun is moved, it then riseth unto us, and setteth unto those that dwell opposite unto us, and so on the contrary. You may conceive it best thus, if standing upon a hill, or some open place, where you may perfectly see the setting of the Sun, you mark when the Sun is half gone out of your sight, you may perceive the body of the Sun cut in two, as it were by a line going along through it, the half above it yet seen, that underneath is gone out of your sight. This line is but a piece of the Horizon, which if you conceive to be drawn upward about the World from the West to the North, and so by East and South, to West again, you have the whole Horizon described.

This Circle is not drawn upon the body of the Globe, because it is variable; but stands on the out-side of it, being a broad circle of wood covered with Paper, on which are set the months and days of the year, both in the old and new Calender, and also the twelve signs, and the points of the Compass. All which are easily discerned by the beholding. The use of this Horizon is not so much in Geography as in Astronomy.

The Zodiack is a circle which compasseth the Earth like a belt, crossing the Equator slopewise, not straight as the Meridians do. Opposite to it in the Heavens is another circle of the same name, wherein are the 12. signes, and in which the Sun keeps his own proper course all the year long, never declining from it on the one side or other. The use hereof in Geography is but little, onely to shew what people they are over whose heads the Sun comes to be once or twice a year; who are all those who dwell within 23. degrees of the Equator; for so much is the declination, or sloping of the Zodiack. This circle is also called the Ecliptick line, because when the Sun and Moon stand both in this circle opposite to each other,

then there happens an Eclipse of the Sun, or Moon, upon a Globe it is easily discerned, by the sloping of it from the Equator, and the divisions of it into 12. parts, and every of those 12 into 30. degrees.

These are the greater circles: the lesser follow; which are all of one nature, and are called by one general name: *ic. Parallels*, because they are so drawn on each side of the Equator, as they are equidistant unto it every way. As is easy to be seen and may be conceived to be drawn upon the earth: but there are only Two sorts chiefly to be marked: namely the

{ Tropicks, and the }
 { Polar circles. }

The Tropicks are two parallel circles distant on each side of the Equator 23 degrees shewing the farthest bounds of the Suns declination North or South from the Equator, or the midst of Heaven. And therefore they are called Tropicks à *regimēdas vertendo*, because when the Sun comes over these lines, he either turns away from us, as in Summer, or turns toward us again as in the Winter: There are then two of them, *viz.*

1. The Tropick of Cancer which lies on the North side of the Equator, to which when the Sun comes, it makes the longest day in Summer.
2. The Tropicks of Capricorne, lying Southward of the Equator, to which when the Sun comes, it makes the shortest day in Winter.

The Polar Circles are two Parallels drawn by the Poles of the Zodiack compassing about the Poles of the World, being distant from them every way 23 degrees.

1. The Arctick Circle that compasseth about the North Pole. It is so called because that in the Heavens (whereunto this in the Earth lies opposite) runs through the constellation of the great Beare. Which in Greek is called *ἄρκτος*.

2. The Antartick circle that compasseth about the South Pole, and is placed opposite unto the former. All these with the former are easily known upon the Globe by these descrip-

descriptions, and names usually added unto them. But because Maps are of an easier price, and more common use then Globes, it will be needful to shew how all these Circles, which are drawn most naturally upon a round Globe, may also as truly, and profitably for knowledge and use be described upon a plain paper. Whereby we shall understand the reason of those lines which we see in the usual Maps of the World, both how they are drawn and wherefore they serve. Understand therefore, that in laying downe the Globe upon a plain Paper, you must imagine the Globe to be cut in two halves thorow the midd, and so to be pressed down flat to the paper, as if you should take a hallow dish, and with your hand squeeze the bottom down till it ly flat upon a board or any other plain thing: for then will those circles that before were of equal distance run closer together towards the midd. After this conceit, universal Maps are made of two fashions, according as the globe may be divided two wayes, either cutting quite through by the Meridian from North to South, as if you should cut an Apple by the eye and the stalk, or cutting it through the *Æquinoctial*, East, and West, as one would divide an apple through the midd, between the eye and the stalk. The former makes two faces, or hemispheres, the East and the west hemisphere, the latter makes likewise two hemispheres, the North and the South: Both suppositions are good, and befitting the nature of the Globe: for as touching such universal Maps wherein the World is represented not in two round faces but all in one square plot, the ground whereupon such descriptions are founded, is less natural & agreeable to the globe, for it supposeth the earth to be like a Cylinder, (or rowl of Bowling-allies;) which imagination unless it be well qualified, is utterly false, and makes all such Maps faulty in the scituation of places. Wherefore omitting this, we will shew the description of the two former onely, both which are easy to be done.

1. To describe an *Æquinoctial* Planisphere, draw a

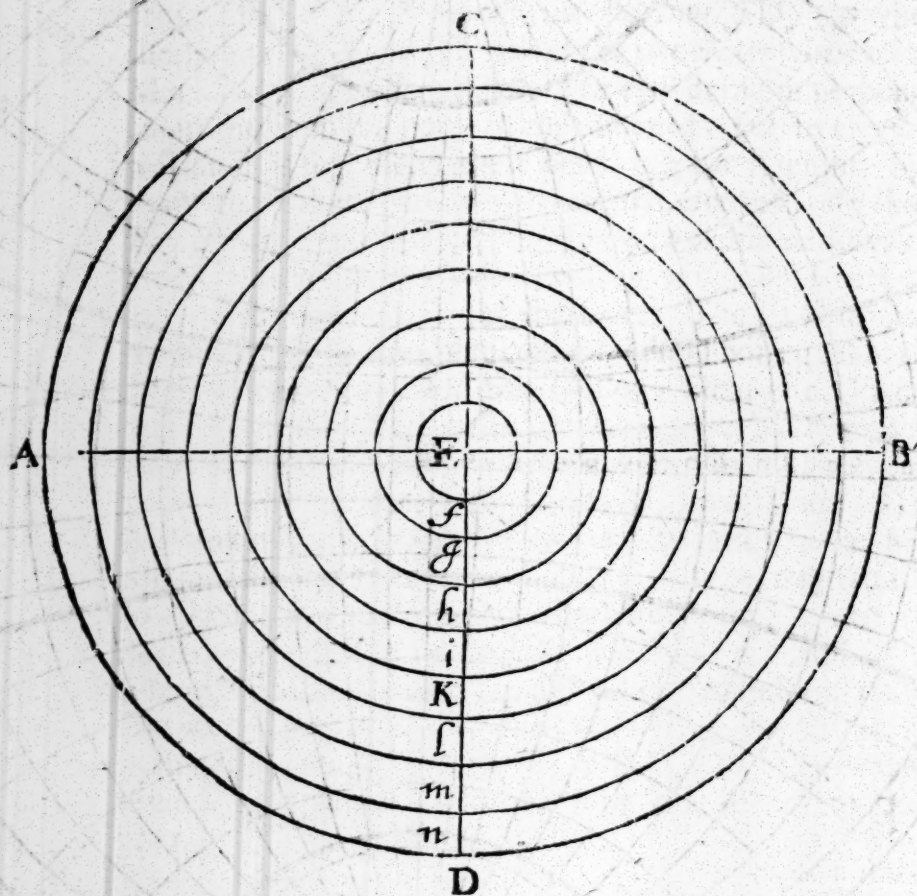
circle as (A B C D) and inscribe into it two diameters (A B) and (C D) cutting each other at right Angles, and the whole circle into four quadrants: each whereof divided into 90 parts or degrees. The line (A B) doth fitly represent half of the *Æquator*, as the line (C D) (in which the points (C) and (D) are of the two Poles) half of the Meridian; for these circles, the eye being in perpendicular line from the point of concurrence, (as in this projection it is supposed) must needs appear straight. To draw the other, which will appear crooked, do thus: Lay a rule from the Pole (C) to every tenth or fifth degree of the half circle (A D E) noting in the *Æquator* (A B) every intersection of it and the rule. The like do from the point (B) to the semicircle (C A D) noting also the intersections in the Meridian (C D): Then the Diameters (C B) and (A B) being drawn out at both ends as far as may suffice, finding in the line (D C) the center of the Tenth division from (A) to (C) and from (B) to (C) and of the first point of intersection noted in the Meridian from the *Æquator* towards (C) by a way familiar to Geometricians: connect the three points, and you have the parallel of 10 degrees from the *Æquator*: the like must be done in drawing the other parallels on either side of the *Æquator*; as also in drawing the Meridians from centers found in the line (A B) in like manner continued. All which is illustrated by the following diagram.

2. To



2. To describe a polar planisphere, draw a circle ($A\hat{C}DB$) on the center (E) and as before, inscribe in two diameters (AB) and (BC) cutting each other at right angles, and the circle into four quadrants. Each quadrants being divided into 90 parts, draw from every 5th or 10th of those parts a diameter to the opposite point

these lines all concurring in the center (E) being the pole, are as so many Meridians. Next, having cut the half



of any one of the former diameters into 9 parts, as (ED,) in the points (FGHIKLMN) draw on the Center (E) so many Circles, and these represent the parallels of the Globe, being also here true parallels.

CHAPTER V.

Let a circle be described with a center (E) and a radius (ED) on the center (E) and as before, intersected by two diameters (AB) and (BC) cutting each other at right angles, and the circle into four quadrants. Each quadrant being divided into 90 parts, draw from every 10th or 20th of those parts a diameter to the opposite point

CHAP. V.

Of divers Distinctions, and Divisions of the Earth.

NExt after the Circles of the Earth, we may not unfily handle the several divisions and distinctions which Geographers make of the parts, and Inhabitants of the Earth. These are many, but we will briefly run them over.

1. The first and most plain is by the coasts of the Heavens, and rising, and setting of the Sun, so it is distinguished into the

East: where the Sun riseth. *Oriens, Ὄρις ἀνατολή.*

West: where the Sun goeth down. *Occidens.*

North: between both fromwards the Sun at Noon.

Septentrio.

South: between both towards the Sun at Noon.

Meridies.

These Four are called the chief or Cardinal quarters of the VVorld. They with the others between them are easily known, but are of more use to Mariners then to us. VVe may rather take notice of those other names which by Astronomers, Geographers, Divines, and Poets are given unto them. VVho sometimes call the East the right hand part of the world, sometime the VVest, sometime the North, and sometime the South, the diversity is noted in these Verses,

Ad Boream terra, Sed Cali mensor ad Austrum.

Preco Dei exortum videt, occasumque Poeta.

That is Geographers look to the North, Astronomers to the South, Priests turn them to the East, and Poets to the West.

This

This serves for understanding of Authors, wherein any mention is made of the right or left part of the World. If for Example he be a Poet, he means the South by the right hand, the North by the left; because a Poet turns his face to the West and so reckons the quarters of Heaven and Earth.

2. The second distinction is by the notable differences of heat and cold, that are observed on the Earth, this is the division of the Earth by Zones or Girdles, which the parts of the Earth, wherein heat and cold do remarkably increase or decrease. Those Zones are 5:

1. The hot or burning Zone (*Zona Torrida*) which contains all that space of Earth, that lieth between the two Tropicks, supposed heretofore (but falsely as after experience hath shewed) to be inhabitable by reason of heat, the Sun continually lying over some part of it.

2. 3. The temperate Zones wherein neither heat nor cold is extream but moderate: those are two, one on the North side of the Equator, between the Arctick circle, and the Tropick of Cancer, another on the South side between the Tropick of Capricorn, and the Antarctick circle.

4. 5. The cold or frozen Zones, wherein cold for the most part is greater then the Heat; these likewise are two, one in the North between the Arctick circle and the North-Pole, another on the South between the Antarctick circle and the South-Pole. These of all parts of the earth are most inhabited, according as extremity of cold is always a greater enemy to mans body then extremity of heat.

2. The third distinction is by the shadows, which bodies do cast upon the Earth, just at noon day; for these do not allways fall one way but diversly according to their divers situation upon the Earth. Now in respect of the shadows of mens bodies, the inhabitants of the earth are divided into the

1. *Amphiscii* (*ἀμφοτεροι*) whose shadows at noon-day fall

fall both ways, *sc.* to the North when the Sun is Southward of them; and to the South when the Sun is Northward; and such are those people that dwell in the hot Zone. For the Sun goes over their heads twice a year, once Northward and another time Southward. When the Sun is just over their heads they are called *Astori*, *sc.* without shadow.

2. *Heteroscii* (*ἑτερόσκοι*) whose shadows do allways fall one way, namely always towards the North: as those that dwell in the Northern temperate Zone, or allways to the South, as those that dwell in the Southern temperate Zone. (A) or (C)

3. *Periscii* (*περίσκοι*) whose shadows go round about them, as those people who dwell in the two cold Zones, for as the Sun never goes down to them after he is once up, but allways round about, so do their shadows.

4. The fourth distinction is by the situation of the Inhabitants of the earth, compared one with another, who are called either,

1. *Periæci* (*περίηκοι*) such as dwell round about the earth in one and the same parallel, as for Example under the Tropick of Cancer.

2. *Antæci* (*ἀντίηκοι*) such as dwell opposite to the former on another parallel of the same distance from the Equator. As those under the Tropick of Capricorn.

3. *Antipodei* (*ἀντίποδες*) who dwell just under us their feet opposite to ours.

5. The fifth distinction is of the length and breadth of the Earth, and places upon it: there may be considered two wayes.

1. Absolutely, and so the

{ Longitude or length of the Earth is its circuit, and Extension from East to West.

{ Latitude or breadth of it, is the whole circuit and compass of it from North to South.

2. Comparatively, comparing one places situation with another, and so the

F

Lon.

Longitude of a place, is the distance of it from the first Meridian going through the Canary Islands Eastward. Whereby we know how far one place lies East or West from another.

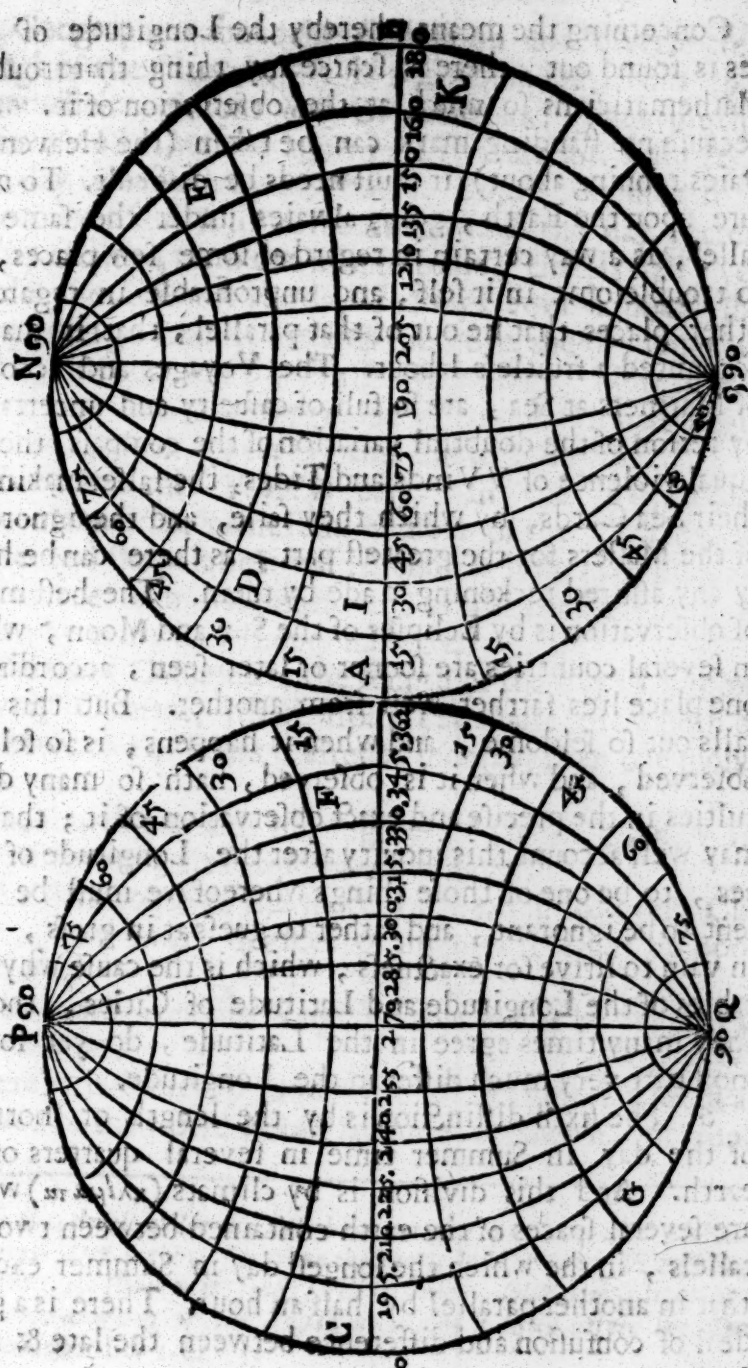
Latitude of a place, is the distance of it from the Equator towards the North or South: whereby we know how far one place lies Northward, or Southward of another.

The Longitude must be reckoned by the degrees of the Equator, the Latitude by the degrees of the Meridian.

For Example, in these two Hemispheres, the longitude of the whole Earth is from (C) to (A) and (B) in the Equator. The Latitude is from (N) to (S) and from (Q) to (P) the North and South Poles, and this reckoned in any Meridian. The first Meridian is (ANBS) which goes by the Canary Islands, The Equinoctial is (ABCA) Now I have a City given *sc.* (D.) I would know in what Longitude and Latitude it is. For the Longitude I consider what Meridian passeth through it, which is the Meridian (NDS) which crosseth the Equinoctial in (I) at 15. degrees, wherefore I say that (D) stands Eastward from the Meridian 15 degrees. So I find that the City (E) is 150 degrees Eastward, (G) 195, and (F) 345.

For the Latitude I consider what Parallel runs through (DEG) or (F) and I find the 30 to pass by (D) 45 by (E) the 15 by (F) the 45 Southward by (G) and those numbers are the Latitude of the place, that are distant from Equator, (GAB.)

Con-



Concerning the means whereby the Longitude of places is found out, there is scarce any thing that troubled Mathematicians so much as the observation of it. For because no standing mark can be taken (the Heavens alwaies running about) it must needs be difficult. To measure upon the Earth, going alwaies under the same parallel, is a way certain in regard of some few places, but so troublesome in it self, and unprofitable in regard of other places that lie out of that parallel, that it may be accounted a fruitless labour. The Voyages and accounts of Mariners at Sea, are so full of casualty and uncertainty by reason of the doubtful variation of the compass, the unequal violence of VVinds and Tides, the false making of their Sea Cards, by which they faile, and the ignorance of the Masters for the greatest part, as there can be hardly any assured reckoning made by them. The best means of observation is by Eclipses of the Sun and Moon, which in several countries are sooner or later seen, according as one place lies farther west from another. But this also falls out so seldome, and when it happens, is so seldom observed, and when it is observed, hath so many difficulties in the precise and exact observation of it; that we may well account this inquiry after the Longitude of places, to be one of those things whereof we must be content to be ignorant, and rather to guess at in gross, than in vain to strive for exactness, which is the cause why the tables of the Longitude and Latitude of Cities, though they many times agree in the Latitude, do yet for the most part very much differ in the Longitude.

6. The sixth distinction is by the length or shortness of the day in Summer time in several quarters of the earth. And this division is by climats (*κλίματα*) which are several spaces of the earth contained between two parallels, in the which the longest day in Summer exceeds that in another parallel by half an hour. There is a great deal of confusion and difference between the late & ancient

ent Geographers about the distinction and diverse reckonings of the Climates. It is not worth the labour to recount their opinions and Calculations: Thus much is plain, and easy to be known: There are 24. Climates, in the day increaseth by half hours, from 12. houres to 24. There are likewise six Climates in which the day increaseth by months, from one month to six, that is half a year. Under the Equator the day is always twelve hours long but as you go from it towards the Pole, the day lengthens till it come to a day, half a year long. Now in what degrees of Latitude every one of these Climates begins and ends, shall appear by this Table following.

The use of this Table is easy. In the first Columne are contained the names and number of the Climates. In the second the parallels which enclose it on each side, and divide it in the middle. For the parallels here are drawn by every half hours increase.

The third Columne is the length of the day in Summer in every Climate, which from 12. hours increaseth by half hours to 24. hours, after by months, from one month to six.

The fourth contains the degrees of Latitude, how far every Climate, lies from the Equinoctial.

The fifth contains the space or breadth of every Climate, how many degrees or minutes it takes up upon the Earth.

The sixth contains some notable places by which the Climates pass.

Hereby it is easy to know what the longest day is in any place of the world whose latitude is known, or con-

TABLE

Those that dwell under the Pole have not past 3 or 4 months profundas tenebras dark-night, for when the Sun is in Libra and Pisces being the night, the Horizon it sends forth to them a Glimmering light not unlike to the dawning of the day in a morning a little before the Sun rising. Munster lib. 1. cap. 5.

trarily

trarily the longest day being known, to know the latitude. For Example *Oxford* hath latitude 52.0. degrees, longitude 24.0. In the Table I find that 52 degrees of latitude lie in the ninth Climate wherein the day is 16 hours and a half long, so much I say the day is at *Oxford* in Summer. The place of *Oxford* in the hemispher is at Y. T.

Upon Globes the Climates are not usually described, but are noted out upon the brazen Meridian. So also in universal Maps they are seldome drawn, to avoid confusion of many lines together, but they are many times marked out on the limb or edge of the map.

The seventh and last distinction of the earth is taken from the scituation of it in respect of the Heavens, and especially the Suns motion. In regard whereof some parts or inhabitants of the earth, are said to be, or dwell in a right sphear, some in a parallel sphear, and others in an oblique or crooked sphear.

They dwell (in *Sphæra recta*) in a right or straight sphear who dwell just under the Equinoctial, whose Horizon is parallel to the Meridians, but cuts the Equator at right Angles.

They dwell in parallel Sphears, who dwell just under either of the Poles, whose Horizon is parallel to the Equator, but cuts all the Meridians at right Angles: and the latter is sometime called a parallel sphear.

They dwell in (*Sphæra Obliqua*) in a crooked sphear, who inhabit any place between the Equinoctial and the Pole whose Horizon cuts the Equator, the parallels, and the Meridians at oblique or unequal Angles.

CHAP.

CHAP. VI.

Of the measuring of the Earth.

WE are now come to the last point concerning the measuring of the Earth, which is two-fold,
 either of the { 1. Whole Earth.
 2. Several parts thereof, and their distance one from another.

Concerning the first it is but a needless labour to recount, the diversity of opinions that have been held from time to time by learned Geographers, what is the compass and depth of the Earth. This may be seen in *Hues de use Globi, part. 3. cap. 2.* and in *Clavius* on *Sacroboſco* with others. They all differ so much one from another, that there is no certainty in trusting any of them. The most common and received opinion is, that the circuit of the earth is 31600 miles, reckoning 60 miles for every degree, and then the depth or Diameter of the Earth shall be 6877 English miles, containing 5000 foot in a mile.

The means whereby the circuit and diameter of the earth: are found out are principally two.

1. By measuring North or South, under one Meridian some good quantity of ground, threescore or an hundred miles (or two for the more certainty) for in those petty observations of small distances there can be no certain working. This may be done, though it be laborious, yet exactly without any sensible error by a skilful workman plotting it but upon his paper, with due heed taken that he often rectify the variation of the needle (by which he travels) upon due observations, and that all notable ascents

44. *A Brief INTRODUCTION.*

and descents, with such winding and turning as the necessity of the way cauſeth, be reduced to one ſtraight line. By this means we ſhall know how many miles in the earth anſwering to a degree in the Heavens, if exact obſervation by large inſtruments be made to find the elevation of the Pole, in the firſt place where we begin to meaſure, and the laſt where we made an end.

Befides this way of meaſuring the circumference of the earth, there is none other that hath any certainty of obſervation in it. That by Eclipſes is moſt uncertain, for a little error in a few minutes of time (which the obſervers ſhall not poſſibly avoid) breeds a ſenſible and ſmall error in the diſtance of the two places of obſervation. That of *Eratoſthenes* by the Sun beams, and a ſhadow of a ſtile or Gnomon ſet upon the earth, is as bad as the other. For both the uncertainty of the calculation is ſo ſmall quantity as the ſhadow and the Gnomon muſt needs have and the difficulty to obſerve the true length of the ſhadow, as alſo the falſe ſuppoſition whereupon it proceeds taking thoſe lines for parallels which are not, do manifeſtly ſhew the reckoning hereby made to be doubtful and not ſure.

2. The ſecond is by meaſuring the ſemi diameter of the earth: For as the circumference makes known the diameter, ſo doth this the circumference. This may be done by obſervation made upon ſome great hill, hard by the ſea ſide. The invention is of *Maurelyanus* Abbot of *Miſſa* in *Sicilia*, but it hath been perfected, and more eaſily performed by a worthy Mathematician *Elmo* who himſelf made proof of it. By this art was the ſemi diameter of the earth to be 183 12621 foot: which allowing 5003 foot to a mile is 3662 and a half miles; which doubled is the whole diameter 7325 miles. The circuit of the earth ſhall be 23030 miles; and one degree contains 63 $\frac{1}{2}$ miles, which is almoſt 64 miles; which as it exceeds the ordinary account, ſo may we reſt upon it as more exact than any other.

2. The second point concerning the measuring of particular distances of places one from another is thus performed.

First upon the Globe it is most easy. With a pair of Compasses take the distance between any two places howsoever situated upon the Globe, and apply the distance so taken to the Equator, and see how many degrees it takes up; those degrees turned into miles shew the distance of the two Cities one from another. Upon Universal Maps there is a little more difficulty in finding the distance of places, which here must be considered in a three fold difference of situation:

1. Of Latitude only.

2. Of Longitude only.

3. Of Latitude and Longitude together.

1. If the two places differ only in Latitude, and lie under the same Meridian, if the places lie both on one side of the Equator the difference of the Latitudes, or the summe of both Latitudes added together, if one place lie North and another South, being turned into miles gives the true distance.

2. If the places differ only in Longitude, and lie both under one parallel of latitude, the difference of Longitude turned into miles proportionably according to the Latitude of the parallel, gives the true distance.

3. The distance of places differing both in Latitude and Longitude may thus be found out, first let their be drawn a semicircle upon a right diameter noted with (ABCD) whereof (D) shall be the center. The greater this semicircle is made, so much the more easy will the operation; because the degrees will be larger.

G

Then

Then this semicircle being drawn, and accordingly divided, imagine that by the help of it, you desire to find out the distance betwixt *London* and *Jerusalem*, which Cities are known to differ both in Longitude and Latitude. Now that the true distance betwixt these two places may be found out, you must first subtract the lesser Longitude out of a greater, so shall you find the differences of their Longitudes; which is 47 degrees. Then reckon that difference upon the semicircle, beginning at (A) and so proceed to (B;) and at the end of that difference make a mark with the letter (E) unto which point by your ruler, let a right line be drawn from (D) the center of the semicircle. This being in this sort performed, let the lesser latitude be sought out which is 32 degrees, in the aforesaid semicircle, beginning your account from the point (E) and so proceed towards (B,) and at the end of the lesser latitude let another point be marked out with the letter (G) from which point, let there be drawn a perpendicular line which may fall with right angles upon the former line drawn down from (D) to (E) and where it chanceth to fall, there mark out a point with the letter (H.) This being performed let the greater latitude which is 51 degrees 52 minutes, be sought out in the semicircle beginning to reckon from (A) towards (B) and at the end of that latitude set another point signified out by the letter (I) from whence let there be drawn another perpendicular line that may fall with right Angles upon the Diameter (AC.) and here mark out a point with the letter (K,) this done take with your compass the distance betwixt (K) and (H) which distance you must set down upon the diameter (AC) placing the one foot of your Compass upon (K) and the other towards the center (D) and there mark out another point with the letter (L) then with your compass take shorter perpendicular line (GH,) and apply that wideness upon the longer perpendicular line (IK,) placing the one foot of your compass at (I) which

which is the bounds of the greater Latitude, and extend the other towards (K,) and there make a point at (M) then with your compass take the distance betwixt (L) and (M) and apply the same to the semicircle, placing the one foot of your compass in (A) and the other towards (B,) and there mark out a point with the letter (N) now the number of degrees comprehended betwixt (A) and (N) will express the true distance of the two places, which will be found to be 39 degrees: which being multiplied by 60 and so converted into Miles according to the former rules, which will produce 2340. which is the distance of the said places.

FINIS.

WATER GEOMETRY

which is the name of the greater Latitude, and extend
 it towards (M) and there make a point (N) then
 with your compass take the distance between (L) and (M)
 and apply the same to the Latitude, placing the one
 foot of your compass in (A) and the other towards (B) and
 there make out a point with the letter (N) now the num-
 ber of degrees comprehended between (A) and (L) will
 exactly the true distance of the two places, which will
 be found to be 22 degrees, which being multiplied by
 60 and the result will be the distance in the former
 miles, which will produce 1320, which is the distance
 of the said places.

906
7.

EXPLANATION

